



## ESS Annual Review 2012

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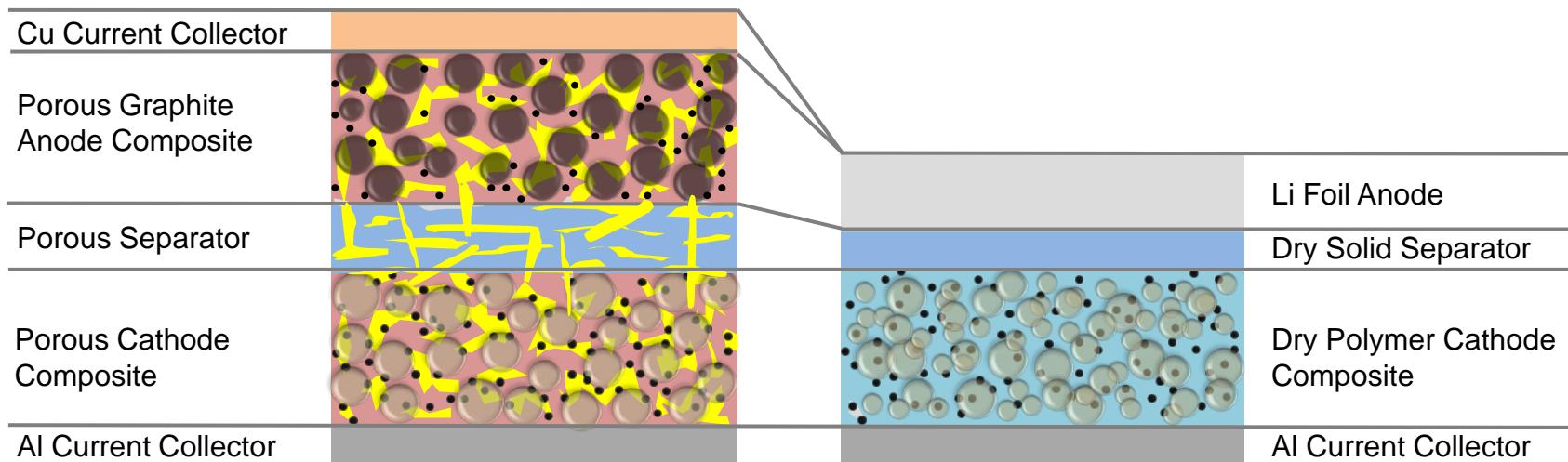
Funded in part by the Energy Storage Systems Program from the Department of Energy  
through the *National Energy Technology Laboratory*

# Seeo's solid polymer battery



## Conventional Li Ion

## Seeo Battery



Element	Li Ion	Seeo	Seeo Benefits
Electrolyte	Liquid	Solid	<b>Safety: Non-reactive and non-flammable</b>
Anode	Porous	Solid	<b>Energy: Superior specific energy (Wh/kg)</b>
Cathode	Porous	Solid	<b>Reliability: High temp stability, minimal fade</b>

# Objective: Build and evaluate battery pack



## Seeo Cells



## Seeo Module



# Polymer optimization and scale-up



Polymer development



Polymer collection & centrifuge



Polymer vacuum drying



Final polymer bagged

# Pilot production process flow: Cells



## Electrode Fabrication



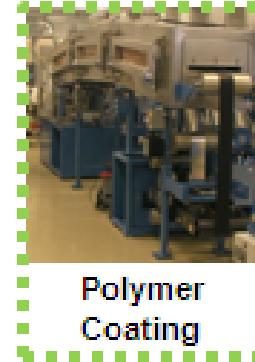
Cathode Mix



Cathode Coating



Cathode Calendar

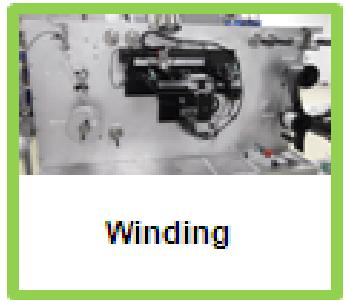


Polymer Coating



Drying

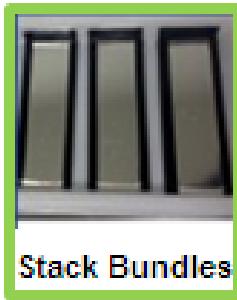
## Cell Assembly



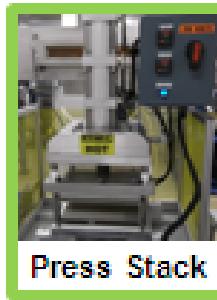
Winding



Laminate



Stack Bundles



Press Stack



Tab Weld



Pouch Seal

Commercially available cell manufacturing equipment

Conventional process flow with electrolyte coating vs. fill

# Safety testing example: Crush tests



X-Axis



Y-Axis



Z-Axis



# Crush test example: Y-axis



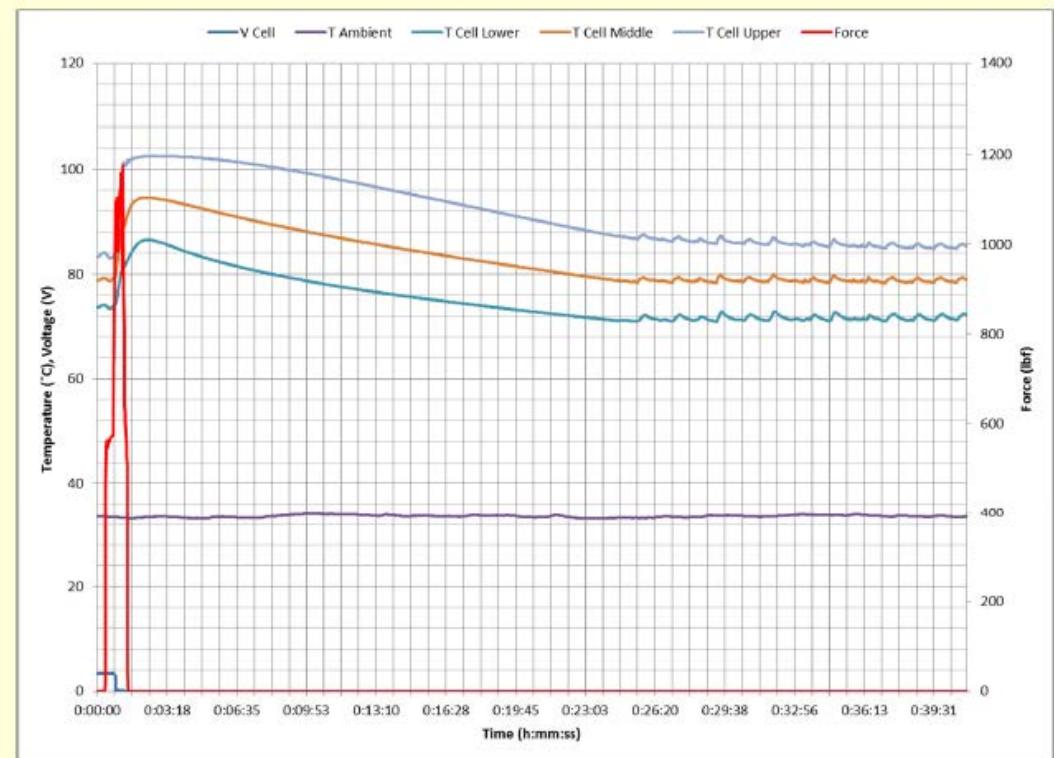
Most aggressive crust test: along axis with terminals

Exponent

38

1205347.000 A0F0 0912 AA02

## Test Results: Cell #3



E<sup>x</sup>(40)

Li-ion:  $\Delta T = 60$  to  $100^\circ\text{C}$  or enter thermal runaway

Seeo:  
Max  $\Delta T = 23^\circ$

No venting, smoke or flames observed for any nail & crush

## Scalable Module



Capable of meeting various voltage and current requirements

Integrated BMS for solid polymer cells

Fully sealed

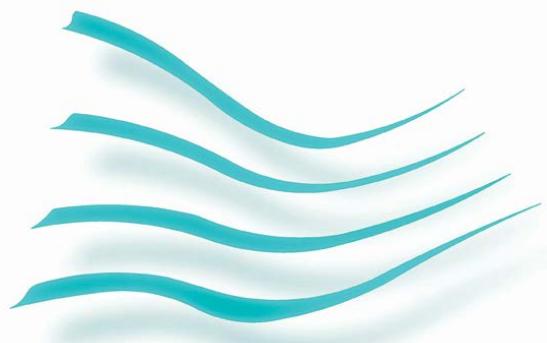
## Battery Pack



Flexible orientation to fit in required space

System-level BMS functions

Efficient thermal management



Q&A